NAVY MEDICINE

September-October 1999

NAVY MEDICINE, Vol. 90, No. 5, (ISSN 0895-8211 USPS 316-070) is published bimonthly by the Department of the Navy, Bureau of Medicine and Surgery (MED 09H), Washington, DC 20372-5300. Periodical postage paid at Washington, DC.

POSTMASTER: Send address changes to *Navy Medicine*, Bureau of Medicine and Surgery, ATTN: MED 09H, 2300 E Street NW, Washington, DC 20372-5300.

NAVY MEDICINE is published from appropriated funds by authority of the Bureau of Medicine and Surgery in accordance with Navy Publications and Printing Regulations P-35. The Secretary of the Navy has determined that this publication is necessary in the transaction of business required by law of the Department of the Navy. Funds for printing this publication have been approved by the Navy Publications and Printing Policy Committee. Articles, letters, and address changes may be forwarded to the Editor, *Navy Medicine*, Bureau of Medicine and Surgery, ATTN: MED 09H, 2300 E Street NW, Washington, DC 20372-5300. Telephone (Area Code 202) 762-3244, 762-3248; DSN 762-3244, 762-3248. Contributions from the field are welcome and will be published as space permits, subject to editing and possible abridgment.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

NAVMED P-5088

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COVER: Flight operations as seen from Vulture's Row aboard USS *John C. Stennis* (CVN-74). Noise reduction in such environments has become a priority in protecting crewmembers from hearing loss. Story on page 21. Photo by Kurt Yankaskas, Naval Sea Systems Command, Arlington, VA.

Mercy Engineering Up to the Task

Moored to pier Six at Naval Station, San Diego, CA, USNS *Mercy* (T-AH 19) rarely leaves her home. The exercises she does embark upon last usually no more than a week, once every 2 years. However, the fewer times a ship deploys, the more preparation and the more people it takes to get her under way.

Not in the case of the *Mercy*, however. While the ship is in reduced operating status (ROS), only five Military Sealift Command civilian mariners are assigned to the engineering department full time. "They must maintain the ship in such a state that it can be activated and fully operational in 5 days," said Loren Massey, *Mercy*'s chief engineer. Five people do the job of the 30 others that join them in the few days before the ship sails. They are in charge of the constant upkeep and maintenance of the ship during the times she's in port. It's the responsibility of those 5 to train and teach the 25 new arrivals every time the ship deploys.

Most times, the temporary mariners that report aboard have never been on a ship like *Mercy*, so learning the ropes is no easy task. Add to that the fact that they must constantly take part in all the fire and man overboard drills, and other emergency drills that the rest of the crew takes part in.

Keeping up a steam-powered ship the size of *Mercy* is a tough job. Before the ship even leaves the pier, the civilian mariners, both new and old, must do a number of things in preparation, including either flooding or draining equipment on board, activating heat exchangers, and placing all machinery in service.

In addition to the jobs that must be completed prior to getting under way, there are unexpected incidents that must be dealt with as well. Leaks, frozen regulators, and flooding are a few of the problems mariners must overcome, once, that is, they have become familiar with *Mercy*'s innerworkings. "Ultimately, it's a huge amount of responsibility and demand placed on the five ROS personnel," said Massey. "Both success and failure are credited to the five ROS engineers."

The job of getting *Mercy* mission-ready primarily falls on the shoulders of the 5 ROS engineers, then the 25 mariners who report on board. If still more support is needed, the Military Sealift Command's San Diego Port Engineer Deniz Ovecoglu handles the task. According to Massey, "[Ovecoglu] makes arrangements with outside contractors to complete items identified by the ship's force. He plays a vital role in getting the ship under way."

There is another group of individuals Massey credits for the success of the mission. "There is no way the engineers could accomplish the mission without hand-in-hand cooperation with the Sailors attached to the medical treatment facility," he said.

When asked if the tasking in the *Mercy*'s engineering department ever becomes too overwhelming, Massey is quick to respond. "The *Mercy* is a marvelous medical facility capable of saving life and limb of American Soldiers, Sailors, Airmen and Marines." he said. After a brief pause, he continued, "In my view, the energy expended in support of this facility is a small price to pay." ❑

—Story by JO3 Stacy Rose, TRICARE Public Affairs, Southern California, Region Nine

Great Lakes Corpsmen Train With Air Force Medics

Recently, Plans, Operations and Medical Intelligence Officer LT Youssef Aboul-Enein, MSC, traveled with nine hospital corpsmen to Milwaukee, WI, home of the 440th Air Wing. There they learned to reconfigure a C-130 aircraft to handle medical casualties.

"Knowing that the C-130 is an important airframe for first echelon medical evacuation, I seized the opportunity to have corpsmen become familiar with this workhorse and to see how Air Force personnel do business as part of joint military training," said Aboul-Enein.

The hospital corpsmen arrived early at Mitchell Field to be trained and to participate in an exercise coordinated by the Veterans Administration Hospital, the State of Wisconsin, and federal authorities. In the exercise, a bomb would explode in Minneapolis, MN, overwhelming the medical system and requiring the transportation of casualties to Milwaukee and four other cities in the Midwest. Once trained, the Great Lakes, IL, hospital corpsmen would work in tandem with the 440th Air Wing. They would off-load moulaged casualties arriving by C-130 and provided by the 109th Aeromedical Evacuation Squadron attached to the Minneapolis Air National Guard.

"I have orders to the USS *Wasp* (LHD-1) and wanted to be familiar with patient care aboard a C-130 in case the need arises for me to escort an injured Marine or Sailor," remarked HN Matthew Riechl.

At 0700 the hospital corpsmen began their training in the classroom where Mr. Fred Robinson, the 440th Chief of Readiness, explained the scenario and issued them gloves and hearing protection. Chief Master Sergeant (CMSGT) George Kuzma, USAF-R, gave a safety brief and escorted the Navy personnel to the flight line. CMSGT Kuzma, with 17 years of experience as a medical evacuation coordinator, was the instructor for the day.

The group spent 3 hours in hands-on training. "The training was excellent. We were oriented as to the stanchions needed to configure the plane to carry litters and the type of medical equipment on board. We then had an hour-long course on how to carry patients and load the plane with casualties," said HN Michelle Meertens.

HM1 Gary Baum

Hospital corpsmen learn the rudiments of aeromedical evacuation.

HM2 Jeffrey Diffy went on to say, "We learned a lot of Air Force jargon like "front-end guys"—the pilot and navigator—and "back-enders"—the loadmaster and medical crew." 1stLT Cynthia Eaton, USAF-R, the 440th Air Wing flight nurse, explained that the C-130 can carry up to 74 patients and typically a crew of four to five medical personnel. She then directed HM3(FMF) William Harris and HM3 David Holzhunter in ways of approaching the airplane with a patient.

The corpsmen also met Senior Airman Spencer Hoyt, USAF-R, a former corpsman and graduate of Hospital Corps School. Among other things, he taught them that IV fluids are to be free of air, a Heimlich Chest Drain Valve must be in place with a chest tube, and Foley Catheters are to be inserted with water not air. The corpsmen also learned many other techniques used to guard against adverse outcomes brought on by changes in cabin pressure.

After the training the team went to the hangar bay, the designated triage center for the exercise. On hand were local ambulances and representatives of fire departments and federal agencies.

The C-130 from Minneapolis landed. The simulated casualties were moulaged victims from local Minneapolis high schools. Great Lakes hospital corpsmen went into action off-loading 34 casualties in 15 minutes, taking direction from CAPT JoEllen Evavold, USAF-R, flight nurse from the 109th Aeromedical Squadron on board.

After triage, the patients were transported to area hospitals in Milwaukee and then returned to the flight line. The Great Lakes corpsmen then loaded the plane again in 10 minutes and the C-130 was on its way to Detroit to do it all over again. "The corpsmen made a few friends that day and became familiar with their sister service. It was a Saturday well spent," said HM1 Anita Madche, the senior hospital corpsman accompanying the group. ❑

—Story by HM3 Christine Stitt, Public Affairs Office, Great Lakes, IL.

Green Men Measure Radio Frequency Energy Absorption on a Land-Based Carrier Deck

Flight crews working on the deck of an aircraft carrier and touching metal surfaces are perfect conduits for the radiated high radio frequency (RF) energy commonly used in ship-to-ship communications. Planes parked on the flight deck re-radiate the energy. The highest energy is re-radiated from a plane's nose, tail, and wingtips. Aboard ship, exposure to RF energy is usually not noticed or acutely sensed by busy flight deck personnel. But sometimes, when touching an aircraft parked near a transmitting antenna, a warming sensation is felt in the wrists and ankles. This sensation is similar to the warmth felt from strong sunlight or engine room heat.

To study RF energy absorption, a simulated land-based project is part of current research efforts at the Naval Health Research Center (NHRC) Detachment at Brooks AFB, San Antonio, TX. According to Dr. Richard Olsen, the principal investigator on the research project, "Access to an actual aircraft carrier during operations to measure exposure is nearly impossible. Previously, only estimates were available. The results of this study will provide actual measurements under highly realistic conditions."

To do this, Dr. Olsen's team of biomedical engineers is studying how wavelength, body size, and body shape determine absorption. They use full-scale anatomically based "green men."

***Opposite page and left*: Dr. Richard Olsen, principal investigator, positions the green man model beside a Navy fighter.**

These life-sized figures weigh 70 kg (154 lbs.) and are filled with nontoxic ground-up polyethylene, salt, cold water, and a protein-based gelling agent. Dr. Olsen points out, "The green man model takes on the size, weight, and shape of a typical sailor. It is composed entirely of a water-based material that resembles the body's high-water-content tissues such as muscle, brain, and blood. Human size and shape are needed to properly interact with the shipboard-radiated frequencies and with full-size aircraft. Thermal probes that do not interfere with RF radiation are inserted into the model to measure localized RF-induced heating."

The green men are placed near a Navy fighter that is permanently tethered to a groundplane designed to simulate an aircraft carrier flight deck. The 60- by 60-ft groundplane, christened the USS *Reliance*, is the only one of its kind in DOD being used for biomedical research. The test aircraft is a Marine Corps "Black Knight" squadron F/A-18 Hornet from El Toro Marine Corps Air Station, CA.

Dr. Olsen describes the groundplane, "Our outdoor irradiation system physically resembles a carrier's flight deck in many ways. We use an actual transmitting antenna from a ship mounted on the edge of our groundplane similar to a carrier's deck-edge HF antennas. Our transmitting power is the same as aboard ship. During exposure at various frequencies through the HF band (2-30 MHz), we position the green man model at various locations around the aircraft to simulate the normal activities during flight operations. The model is dressed in clothing and work boots. Any RF-induced warming will be representative of "real-world" flight deck conditions. We expect to show a high degree of radiation safety in typical operational scenarios. The results of this research will ultimately provide additional protection to flight deck personnel."

The laboratory's researchers look for ways to improve fleet occupational safety and health. Dr. Olsen adds, "At Brooks Air Force Base, the Detachment's research projects focus on the biological effects of nonionizing radiation over an extremely wide frequency spectrum, from a few megahertz to nearly 100 gigahertz. We explore and quantitate all types of radiation-induced effects. The increasing use of electromagnetic energy in the Navy environment includes millimeter wave communications, electric propulsion, and directed energy weapons. Developing solid research-based knowledge of the biological effects will keep the Navy on the leading edge of technology utilization consistent with realistic safety and health considerations." ❑

For more information on research conducted at the NHRC Detachment, visit the website at *http://brooks.af.mil/NHRC/nhrc.htm*.

—Story by Doris M. Ryan, Medical Research and Development Division (MED-26), Bureau of Medicine and Surgery, Washington, DC. Photos by Naval Health Research Center Detachment, Brooks AFB, San Antonio, TX.

Navy Researchers Help Design New Medical Bag for FMF Hospital Corpsmen

HMC(FMF) Lowe demonstrates the new medical bag. Designed to replace the Unit One, the new bag is bigger, contains more supplies, and unfolds to become a working platform for use in all environments.

Trained in resuscitative care and emergency medicine, Fleet Marine Force (FMF) hospital corpsmen learn combat survival techniques and take their medical skills to the field with the Marines. In combat, they are the first to provide lifesaving medical care and the first link in the survival chain that moves casualties from the field through other levels of care. As part of their gear, FMF hospital corpsmen carry a combat medical bag called the Surgical Instrument and Supply Set, often referred to as a "Unit One" (Table 1).

In early 1998 HMC(FMF) Douglas J. Lowe, a program officer at the Marine Corps Systems Command, Quantico, VA, brought together a team of subject area experts to review and redesign the Navy's Unit One into a joint Navy/Army medical bag. With a focus on survivability and improved casualty care, Chief Lowe wanted a new medical bag with quality medical supplies to compliment a hospital corpsman's training and skills and to be configured to meet individual mission needs.

Chief Lowe pointed out, "We looked at the basics and started in the field. We asked questions like, what is happening in the field, how much equipment is needed, how much care is provided, how many patients? To that, we added "ruggedization" issues like heat, cold, high humidity, and long-term storage. We considered space a premium and weight critical. We didn't start with a bag that needed to be filled. We started in the field and made a list

Table 1 UNIT ONE SUPPLY LIST			
Adhesive Tape Surgical 3"X 5 yd (1 ea.)	Airway Pharyngeal Berman Child 80 mm (1 ea.)	Airway Pharyngeal Guedel SZ 4 90 mm (1 ea.)	Aspirin Tablets (2 bt.)
Atropine Inj Aqueous .7ml syringe w/needle (10 ea.)	Bandage Adhesive Flesh .75x3 in. (36 ea.)	Bandage Gauze Compressed Camouflage (2 ea.)	Bandage Muslin Camouflage (2 ea.)
Case Surgical Instrument and Supply Set (1 ea.)	Dressing First Aid Field Brown Camouflage Abd (2ea.)	Dressing First Aid Field 7x7 in. Camouflage (8 ea.)	Pencil Mechanical Black Barrel Auto (1 doz.)
Pin Safety Brass sz 2 1.5" long (1 bx.)	Povidone-Iodine Topical Sol (2 bt.)	Scissors Bandage 7.25", Angle Blunt Pts Crs (1 ea.)	Splint Universal Structural Aluminum (1 pkg.)
Surgical Instrument Set Minor Surgery (1 ea.)	Tetracaine HCL Ophth Sol (2 ea.)	Thermometer Clinical Human Oral Mercury (1 ea.)	Tourniquet Nonpneumatic Camouflage (1 ea.)

Source: Development of a Medical Supply Set for Corpsmen in the Field, NHRC Report No. 98-26

of the FMF hospital corpsman's tasks. This list was used to determine what medical supplies were needed to perform each task. Only when we had those data in hand, did we begin to build the new medical bag."

Paula Konoske, Mike Galarneau, and Kristee Emens-Hesslink, researchers from the Naval Health Research Center (NHRC), San Diego, CA, were part of Chief Lowe's team. They took the list of tasks performed by FMF hospital corpsmen in the field (Table 2) and matched the medical supplies needed to complete each task using a computer model that determines medical materiel utilization. The computer model used for the new medical bag is the same one NHRC developed to review the Marine Corps' Authorized Medical Allowance Lists (AMALs) for far forward medical treatment facilities. Prior to working on the new medical bag supply list, NHRC successfully reconfigured the laboratory, X-ray, battalion aid station (BAS), shock surgical team, ward and operating room AMALs resulting in substantial reductions (approximately 30 percent) in the number of items required, in weight, and in cube while increasing capabilities.

According to Paula Konoske, the principal investigator in the Medical Information Systems and Operations Research Department at NHRC, "In 1996 the Marine Corps asked us to help determine the medical supply configuration for the medical battalions as they were being reorganized. They wanted the amount and type of medical supplies reviewed with the hopes of reducing the weight and cube. We developed a systematic approach which involved identifying the types and frequencies of illnesses and injuries expected in operational environments. Then medical providers with FMF experience determined the medical tasks needed to treat each specific injury and illness. These experts helped us identify the supplies and

Table 2 MEDICAL TASKS PERFORMED BY FMF CORPSMEN IN THE FIELD			
Remove Casualty from Danger *	Apply Tourniquet	Clear Respiratory Airway *	Place in Coma Position *
Occlude Sucking Chest Wound	Wet/Cold Injury Therapy	Triage	Assessment and Evaluation of Patient Status
Establish Adequate Airway	Neurological Assessment	Stabilize Neck/Spine	Recognize and Respond to Hemorrhage
Vital Signs	Start/Change IV Infusion Site	IV Infusion, Change Bottle	Bowel Sounds Assessment
Clean and Dress Wound	Compresses (Soaks)	Apply Ace Bandage	Extremity Elevation *
Apply Sling	Apply Splint Immobilize Injury	Circulation Check	Minor Surgical Procedure
Eye Irrigation	Eye Care (Dressings/Eye Patch)	Sponge/Hyperthermia Treatment	Seizure Care/ Precautions
Patient Restraint Gauze, Ties)	Order/Document Appropriate Meds/Treatment	Administer Appropriate Medication	Force Fluids*
Arrange for Patient Evacuation*	Apply Velpeau Dressing	Intubation	Cardiac Arrest Resuscitation *
Expose Patient for Exam	Prepare for Evacuation Ground/Air*	Induce Vomiting	Arrange and Document Returns to Duty

* No supplies needed for this task

Source: Development of Medical Supply Set for Corpsmen in the Field, NHRC Report No. 98-26

Table 3 SUPPLY LIST FOR THE NEW FIELD MEDICAL BAG			
Airway Nasopharyngeal Robertazzi 30 fr. (1 ea.)	Airway Pharyngeal 100mm Airway/Cutaway 30 fr. (1 ea.)	Airway Pharyngeal 80 mm airway/cutaway 30 fr (1 ea.)	Ammonia Inhalant Sol Aromatic .333 cc amp (10 ea.)
.75x3 in. Bandage Adhesive Flesh (10 ea.)	Bandage Elastic Coban™ Brown (2 ea.)	Bandage Elastic Rolled (4 ea.)	Bandage Kerlix® Roll (6-8 ea.)
Bandage Muslin Camouflage (10-12 ea.)	Blade Laryngoscope Macintosh Size 4 (1 ea.)	Blade Laryngoscope Miller Size 3 (1 ea.)	Catheter & Needle Unit IV 14 GA (5 ea.)
Catheter & Needle Unit IV 18 GA (5 ea.)	Diphenhydramine Hydrochloride Caps 50 mg (1 bt.)	Dressing Burn 4"X6" Saturated w/Water Gel (5 ea.)	Dressing Chest Wound Seal (4 ea.)
Dressing First Aid Field 7x7 in. Brown Camouflage (4 ea.)	Dressing First Aid Field Camouflage Abd.(2 ea.)	Dressing First Aid Field White Absorbent (6 ea.)	Envelope Drug Dispensing Plastic W/Panel (10 ea.)
Epinephrine Syringe Needle Unit 1:1000 (1 ea.)	Field Medical Card DD Form 1380 (1 bk)	Gloves Surgeons Gen Surg SZ 8 Rubber (5 pr)	Intravenous Injection Set 12 Comp Sterile (3 se)
Laryngoscope Handle Lightweight (1 ea.)	Otoscope/Opthalmoscope Basic EENT Set W/Light (1 SE)	Pad Isopropyl alcohol Impreg Nonwoven (16 ea.)	Pad Post-Surgical Obstetrical Super Size (2-3 ea.)
Pen Ballpoint Retractable Med Pt Black (1 ea.)	Ringer's Injection Lactated USP 1000 ML Bag (3 ea.)	**Scissors Bandage 7.25" Angle Blunt Pt Crs (1 ea.)**	Skin Cleanser 60% Ethyl Alcohol No Rinse (1 bt)
Sphygmomanometer Aneroid 300 mm Max Cal (1 ea.)	Splint Finger Aluminum Either Hand (1-3 ea.)	**Splint Universal Structural Aluminum (3-4 ea.)**	Sponge Surgical Cellulose Cotton Gauze (4-6 ea.)
Stethoscope Combination Littman Classic II (1 ea.)	Stylet Tracheal Tube Plastic Sterile (2 ea.)	Support Cervical Large 16-18" Philly (1 ea.)	Support Cervical Medium 13-15" Philly (1 ea.)
Surgical Instrument Set Minor Surgery (1 se)	Syringe Hypodermic GP 10-12 ml Luer Slip (2 ea.)	Tape Adhesive Surgical Porous Woven 3" (1 rl.)	Thermometer Clinical Human Rectal (1 ea.)
Thermometer Clinical Human Subnormal (1 ea.)	Tube Drainage Surg Penrose Amber Rubber (3-4 ea.)	Tube Endotracheal Murphy E12 w/Cuff (2 ea.)	Tube Endotracheal Radiopaque Murphy (2ea)
Zip lock plastic bags 4"X4" (100 ea.)			

Items in bold are from the original Unit One
Source: Development of a Medical Supply Set for Corpsmen in the Field, NHRC Report 98-26

equipment required to accomplish those tasks." By establishing the clinical requirement for each item, the NHRC supply model was able to reduce the logistical burden carried by Marine Corps units.

Chief Lowe said, "NHRC provided a wealth of information. The researchers provided us with the data we needed to make our decisions about the contents of the new bag. The NHRC model links each item carried by the FMF hospital corpsmen to a medical task performed in the field. As technology and requirements change, the NHRC model can be used to replace, add, and delete items in the new medical bag."

Dr. Konoske and her team developed two lists of supplies. The first was a list of items to be carried in the

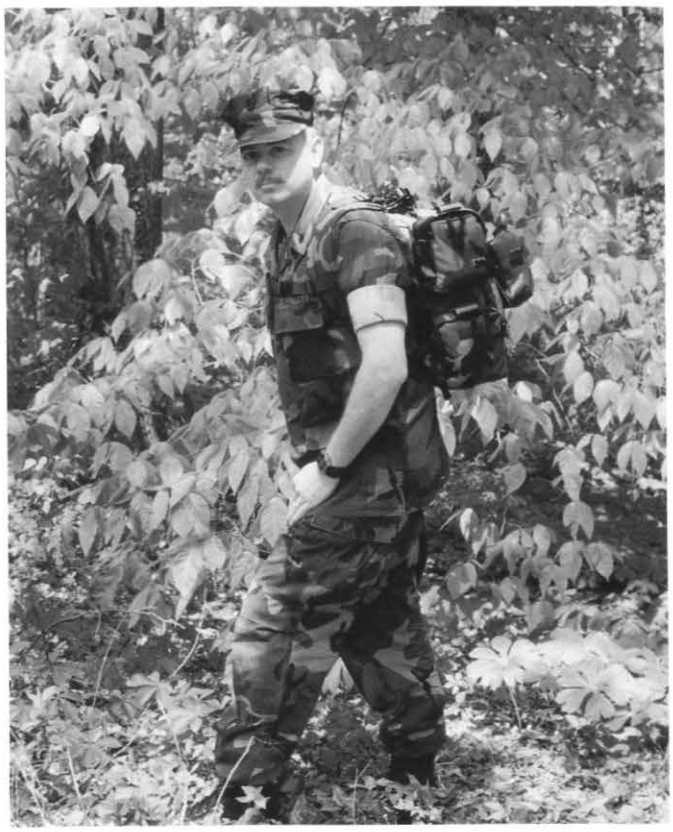
Table 4 MEDICAL BAG SUPPLIES AVAILABLE FROM THE BATTALION AID STATION			
Acetaminophen Tablets .325 GM	Bisacodyl Tablets USP 5 mg Film Enteric bt.	Bismuth Subsalicylate Tablets 262 mg 42/pkg	Cetylpyridinium Chlor & Benzocaine Loz
Depressor Tongue Wood 6"x.75"x.062" Straight	Diazepam Inj USP 5mg/ml2 ml syringe/needle*	Ibuprofen Tablets USP 800 mg 500/bt	Ipecac Syrup 7% 30 ml.
Loperamide Hydrochloride Caps USP 2 mg 100/bt.	Magnesia Alumina Hydrox Simethicone Tabs 50/bt.	Miconazole Nitrate Antifungal Treatment Kit	Morphine Sulfate Inj USP 10 mg Auto Injector *
Oxymetazoline Hydrochloride Nasal Solution .05%	Pad Cooling Chemical Plastic Flexible Pack	Pad Heating Chemical Plast Chem Reaction 110° F	Polyvinyl Alcohol Ophthalmic Sol (Artificial Tears)
Pseudoephedrine Hydrochloride Tablets USP 60 mg	Shield Eye Surgical FOX Single Constr	Sodium Chloride Irrigant	Splint Wood Basswood Overall
Syringe Irrigating Toomey Piston 60 cc	Tape Adhesive Surgical Moleskin 12" x 5 yd	Tape Adhesive Surgical Porous Woven 1"	Tolnafate Topical Solution USP 1% 10 ml.
Towel Pack Surgical Blue/Gray or Green Ster			

* Controlled substance – dispensed by General Medical Officer at the BAS
Source: Development of a Medical Supply Set for Corpsmen in the Field, NHRC Report No. 98-26

new medical bag (Table 3). The second was a list of items that needed to be stocked by the BAS so FMF hospital corpsmen could pack and restock the medical bag with supplies to meet specific mission requirements (Table 4).

The result of the team effort is a new joint medical bag that is mission adaptable and packed with updated medical supplies. The new medical bag will soon be issued to FMF hospital corpsmen assigned to the Marine Corps and will be used during training at the Field Medical Service Schools at Camp Pendleton, CA, and Camp Lejeune, NC.

According to Chief Lowe, "Junior corpsmen coming out of the Field Medical Service Schools can use all the equipment in the bag. As the curriculum at the schools change, those changes will be reflected in the content of the bag."



HMC(FMF) Lowe with the new field medical bag. The eight external pouches can be removed or attached to just about any part of the bag, which allows for individual preference and mission needs.

The New Bag

The original Unit One had 20 items. Six of the original items were retained. These include two types of bandages (muslin and adhesive), a first-aid dressing, a pair of bandage scissors, a universal splint, and the surgical instrument set. The outdated gauze bandage was replaced with the Kerlix® bandage. Fully supplied, the original Unit One weighs approximately 10 pounds. The new medical bag has 48 items. Many of the added items, such as the otoscope/opthalmoscope set and laryngoscope, were not previously available to field hospital corpsmen. Fully supplied the new medical bag weighs approximately 22 pounds.

According to Chief Lowe, "The average weight will probably be between 10 and 18 pounds depending on how the bag is configured and what exactly the hospital corpsman is carrying. Multiple configurations and flexibility are key assets to this system."

Along with the new bag's medical supplies, an additional 24 items will be available from the BAS. These items include several medications (e.g., pseudoephedrine hydrochloride tablets) and other items (e.g., eye shield) that are important but not necessary to save life and limb in the field. Two items (diazepam and morphine) are controlled substances dispensed by the general medical officer. The number of items stocked in the BAS AMALs has increased to account for the FMF hospital corpsmen's utilization.

According to Chief Lowe, "By having additional items at the BAS, FMF corpsmen will have a greater variety of medical supplies available to them when needed and flexibility in packing their medical bag with supplies needed for a specific mission."

The new bag was field-tested in late 1998. Chief Lowe said, "FMF corpsmen evaluated the bag during normal training cycles and in day-to-day unit mission activities including day and night operations. Users found the bag effective, comfortable, and safe and were especially satisfied with the ability to configure the external pouches on the bag as the mission required."

The new medical bag is part of the medical version of the MOLLE System, the Marine Corps' new modular lightweight load-carrying equipment. Chief Lowe said, "The Marine Corps' new modular system and the medical bag were designed at the same time, and the new bag will be issued to the FMF corpsmen as part of their gear." ❑

—Story and photos by Doris Ryan, Medical Research and Development Division (MED-26), Bureau of Medicine and Surgery, Washington, DC.

Medication Cost Containment in Military Anesthesia

CAPT Timothy Sternberg, MC, USN
CAPT William M. Yarbrough, MC, USNR
CDR Gerald Davidson, NC, USN
CDR David Norman, NC, USN
LCDR Gilberto Acosta, MC, USNR
LCDR Michael Beck, NC, USN
LT Marshall E Ashby, NC, USN
LT Melanie C. Phillips, MC, USNR

The economics of medicine, in general, and anesthesia, in particular, have undergone drastic changes in the last decade. Previously, the cost of medications was not a significant part of medical decision making. Currently, the costs of care are receiving an ever-increasing amount of attention. Multiple articles have been published in peer-reviewed medical journals over the last several years.(*1-5*)

The International Anesthesia Research Society has recently introduced a new section, Economics and Health Systems Research, to the monthly journal *Anesthesia and Analgesia*.

The current health care climate mandates that anesthesia care be provided in an efficient manner. Many private practice and university associated anesthesia groups have made significant changes in the way anesthetic medications are used in an attempt to control costs.(*1*)

Economic changes in military anesthesia care may not have been as robust. Newer, more expensive medications may be added to the formulary without due consideration of the cost versus added benefit. The Anesthesia Department at Naval Hospital Charleston, SC, decided to undertake a quality improvement initiative to ascertain if drug costs could be reduced while maintaining high quality of care.

Methods

Anesthetic drugs of the highest cost were identified and placed in categories along with available alternates. The unit prices were researched and a cost-per-case estimated. Patient population and average surgical times at our institution were used in this estimate. We then identified the distinguishing physiologic advantage of the identified drugs. Finally we agreed to protocols on use of the expensive anesthetics as well as the less expensive alternates. The protocols were formulated to assure the patients had the best possible outcomes at the most efficient cost, while minimally restricting the clinical options of the anesthesia provider.

Table 1

Induction Agents:	**Unit Price($/[dose])**:	**Physiologic Advantages**:
Propofol(Diprivan)	$6.97/20ml($5.00)	Rapid recovery, nonemetogenic
Na+ thiopental(Pentothal)	1.81/20ml($1.50)	Rapid onset, nonirritating
Etomidate(Amidate)	14.80/20ml($10.00)	Cardiovascular stability
Inhalation Agents:		
Isoflurane(Forane)	$20.50/250ml	Minimal CV depression
Sevoflurane(Ultane)	136.65/250ml	Rapid onset/clearance, nonirritating
Desflurane(Suprane)	53.33/250ml	Most rapid clearance
Halothane(Fluothane)	12.00/250ml	Nonirritating
Nondepolarizing Muscle Relaxants:		
Cisatracurium(Nimbex)	$10.80/10ml($7.00)	Nonorgan elimination, CV stability
Mivacurium(Mivacron)	15.68/20ml($5.00)	Most rapid spontaneous clearance
Pancuronium(Pavulon)	0.96/2ml($0.50)	Longest acting, mild CV stimulant
Rocuronium(Zemuron)	20.24/10ml($9.00)	Most rapid onset, CV stability
Vecuronium(Norcuron)	13.23/10ml($9.00)	Longest shelf life, CV stability
Antiemetics:		
Droperidol(Inapsine)	$2.09/2ml($0.50)	Potent, sedating
Metoclopramide(Reglan)	0.18/2ml($0.18)	Pro-peristaltic mechanism
Odansetron(Zofran)	129.20/20ml($19.00)	Very effective, minimal side effects
Long Acting Local Anesthetics:		
Bupivacaine(Marcaine)0.5%	$0.90/30ml($0.90)	Minimal CV depression @<[0.75%]
Ropivacaine(Naropin)0.5%	7.19/30ml($7.19)	Least possibility cardiac depression
Lipophilic Opioids:		
Fentanyl(Sublimaze)	$0.83/5ml($0.83)	Potent, minimal CV depression
Sufentanil(Sufenta)	9.18/2ml($9.18)	Potent, minimal CV depression
Remifentanil(Ultiva)	6.83/1mg($6.83)	Rapid clearance

Table 2

Induction Agents:

Propofol(Diprivan): Induction for outpatient surgery, for patients and/or procedures with a high probability of postoperative nausea/vomiting(PONV), for inpatient procedures expected to last <2 hours, or where barbiturates are contraindicated. Continuous infusion for cases expected to last <1.5 hours or where inhalation agents are contraindicated.

Etomidate(Amidate): Induction for cases where CV depression anticipated or cannot be tolerated.

Sodium Thiopental(Pentothal): Standard induction agent for inpatient procedures expected to last >2 hours.

Inhalation Agents:

Sevoflurane(Ultane): Induction for any case using inhalation induction. Maintenance for cases expected to last <1.5 hours, and outpatient procedures.

Desflurane(Suprane): Maintenance for outpatient surgery expected to last <1.5 hours or in short or outpatient procedures where sevoflurane may be contraindicated (e.g., low flow techniques in a patient with significant renal disease.)

Isoflurane(Forane): Standard maintenance agent for inpatient procedures expected to last >1.5 hours.

Antiemetics:

Odansetron(Zofran): For prevention/treatment of patients with a history of intractable PONV, in cases with a high probability of PONV, for patients where the extrapyramidal effects or BP decreasing effects of droperidol would be particularly deleterious, and for patients where the pro-peristaltic activity of metoclopramide should be avoided(e.g., possible bowel obstruction.)

Metoclopramide(Reglan), Droperidol(Inapsine): Standards when the indications for odansetron are not met.

Nondepolarizing Muscle Relaxants:

Cisatracurium(Nimbex): For cases of moderate duration where the nonorgan elimination and nonhistamine releasing effects of cisatracurium would be particularly beneficial.

Mivacurium(Mivacron): For short cases where muscle relaxation anticipated to be needed only for intubation, or for cases of short-to-moderate duration where reversal with anticholinesterases/anticholinergics are to be avoided.

Rocuronium(Zemuron): For cases of moderated duration where rapid onset of relaxation particularly indicated, and for rapid-sequence-induction where succinylcholine is contraindicated.

Vecuronium(Norcuron): For cases of moderate duration where the cardiovascular stability and nonrenal elimination are particularly advantageous.

Pancuronium(Pavulon): Standard for long cases where muscle relaxation will be required for several hours and there is no contraindication to a degree of tachycardia.

Long Acting Local Anesthetics:

Ropivacaine(Naropin): For major conduction blockade in obstetrics/surgery or where the potential of bupivacaine cardiotoxicity must be particularly avoided.

Bupivacaine(Marcaine): Standard for major conduction blockage in surgery.

Lipophilic Opioids:

Remifentanil(Ultiva): For cases of short-to-moderate duration where postoperative pain is expected to be minimal, and rapid emergence/return to function advantageous.

Fentanyl(Sublimaze): Standard for cases where opioid analgesia will be needed during and after the procedure.

Sufentanil(Sufenta): For cases of increased potency/lipophilicity of sufentanil relative to fentanyl offers clear advantage.

Results

Below is the drug utilization protocol developed.

Cost Containment in Anesthetic Medications

Background. As members of the anesthesia care team, our primary mission is high-quality anesthesia and perioperative care with optimal patient outcomes. As stewards of U.S. Government equipment and spenders of taxpayer funds, our related objective is to practice in the most cost-effective manner consistent with our primary mission.

New drugs, equipment, and techniques are continuously developed which enable higher quality patient care. These drugs are usually more expensive per unit than those they replace. We commit ourselves to use these new drugs judiciously and prudently. We will take total benefits (physiological, psychological, etc.) and costs (unit dose, costs of recovery stay, costs of treating of side effects, etc.) into consideration.

Drug Identification. We identify the following medicines as ones whose cost and utilization deserve scrutiny. These drugs, available alternatives, unit costs, cost-per-average-dose, and principal distinguishing physiologic advantages as shown in Table 1.

Drug Use Protocol. We commit to use medications consistent with high-quality anesthetic care, attempting for the best possible outcome, in the most economical manner. In so doing, we will use more expensive medications when they offer an evidence-based advantage over less expensive alternatives. We will strive to use inexpensive agents as standards and restrict use of expensive choice to the following indications in Table 2.

Modification. The protocols described in Table 2 are guidelines subject to change. We will modify the indications based on scientific evidence published in peer-reviewed journals.

Discussion

Newer drugs are continually introduced into clinical practice. They are formulated to have, and certainly marketed as having, distinct advantages over existing alternatives. For example, a particular advantage of the newer intravenous induction agents and inhalation anesthetics is more rapid clearance. Particular qualities of the new nondepolarizing muscle relaxants include more rapid onset (rocuronium), cardiovascular stability with nonorgan elimination (cisatracurium), and rapid spontaneous clearance (mivacurium). Newer antiemetics are generally, though arguably, more effective. Ropivacaine has less cardiac depression compared to bupivacaine.

These advantages come at a cost; at times being several-fold higher than existing alternatives. The comparative costs of the new inhalation agents,(*2*) muscle relaxant,(*3*) and antiemetics(*4*) have been studied. We tasked ourselves with establishing protocols of efficient and effective drug use. More expensive medications were to be used when they have a particular advantage in our practice setting. Less expensive alternatives were to be used otherwise. We committed to make our choices evidence based and discourage practitioners from using expensive medications on empirical grounds only.

Though we encourage other departments to economically analyze their own choices of medication use, our protocol cannot be universally applied. Each hospital has its own patient mix, surgical times, and drug acquisition costs. Particular physiological advantages of the newer drugs may or may not be relevant in different practices.

In conclusion, we developed a drug use protocol that maximizes positive patient outcomes while minimizing cost. Though savings will be difficult to ascertain without a large-scale study, simply becoming aware of cost differences has led several of us to alter our clinical practice. We anticipate that similar to the study by Berman and Simon,(*5*) cost savings can accrue even in the absence of mandated clinical guidelines.

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Feature

Chemical/Biological Warfare Close to Home

CDR Thomas Anderson, MSC, USN

Recently, I had the opportunity to attend an international conference in Croatia entitled "Chemical and Biological Warfare Without Chemical/Biological Weapons." The theme was chillingly simple: What would be the effect on the surrounding community if a chemical plant or biological research facility were deliberately targeted by a battlefield commander or a terrorist?

Croatia is a perfect setting for such a conference. The 1991-1995 war with Serbia was fought almost entirely among civilian population concentrations. The ancient-walled city of Dubrovnik on the Adriatic coast was shelled relentlessly while the residents took shelter in their homes. Several chemical plants and chemical storage sites not far from the capital city of Zagreb were purposely bombed. It was this experience that the Croatians offered to share with the international scientific community.

A highlight of the conference was a mock attack staged at one of the chemical plants bombed during the war. We watched from a nearby hillside as military jets from the Croatian Air Force made low-level bombing runs on the plant. Live explosives sent towering clouds of smoke billowing into the air, far above the 250-foot static head of the water suppression systems. This plant produced ammonia and sulfur compounds, among other chemicals. Gases released in an actual attack would be deadly complex mixtures. The lesson was clearly visible to us. In an attack such as this the plant operators will not be able to control toxic emissions at the source. Clouds of deadly vapors and fumes will sweep across the countryside, over farms, towns, and cities. Casualties from such an incident could number into the thousands, as we learned from the chemical accident at Bhopal, India.

For the remainder of the week we discussed specific incidents from the war, lessons learned, and theory. For example, the Croatian Nuclear Commission described the hazards from lightning rods downed by the shellings. Many lightning rods contain small radioactive sources to enhance their effectiveness. During the shellings, these sources were scattered throughout the population centers. Fortunately, Croatia had a prewar registry program which allowed authorities to locate and retrieve most of the radioactive sources, but the process took months.

We even debated whether anyone can really prepare for a catastrophe like a chemical or biological plant attack. When you add in all the uncontrollable variables, the uncertainties, and the sheer chaos, it's hard to argue that anyone can ever be fully prepared for disaster.

But experience has shown the benefits of advance planning and preparation. The Croatians discussed several ways their community governments, military, and industry are working together to plan and prepare for possible disasters in the future. The war made believers out of them. There were other practical demonstrations at the conference demonstrating new equipment that can help prepare for and recover from disastrous incidents.

Disclaimer: This discussion does not endorse any of the products or companies mentioned, but simply illustrates what is currently available for dealing with emergency situations.

The Canadian Defense Research Establishment (*www.dres.dnd.ca*) demonstrated, again using live explosives, a bomb suppressant system. The suppressant foam is pumped into a small, tentlike structure placed over a bomb. When the bomb explodes the foam absorbs the blast and also neutralizes most chemical and biological agents.

Crosco Chemical Company of Croatia demonstrated a system to extinguish uncontrolled oil-well fires. A mixture of nitrogen gas and water is pumped from a nozzle on a boom. The water cools and the nitrogen smothers, cutting two legs of the fire triangle. We sat close enough to feel the

tremendous heat of the fire yet the extinguisher worked in seconds.

The Dragger Company of Germany, maker of the familiar chemical detector tubes, displayed new five-tube sets specifically designed for use in civil defense situations. One breaks the five tops at the same time and simultaneously draws five sample gases common to urban accident scenes. Dragger also showed new technology they are developing that will replace the common detector tubes with a microchip sensing system. There will no longer be a need to break tubes open and draw gases through them.

And finally, plant engineers from a Croatian chemical plant bombed during the war described how they now use the DuPont SAFER/TRACE computer modeling system. Through computer modeling they are able to plot accidental chemical releases from their plant and predict gas cloud movement under real conditions of topography and prevailing winds. The system will eventually be fitted with chemical sensors placed in the countryside around the plant to trace gases should an accident actually occur.

My point is that chemical and biological warfare is not solely a deployment concern. It can come to us anytime and anywhere, at home or at work. Recall some of the events that have actually taken place recently. Letters were received at a clinic indicating that they contained anthrax; a package marked "anthrax" was discovered sitting in a pool of liquid on a Navy flight line; a railroad tank car crashed near a town releasing toxic chemicals; terrorists released toxic chemicals in a Tokyo subway. When I see these stories in the news, I always ask myself how I would respond if I were the one receiving the first frantic call for assistance.

To help us prepare, we at Navy Environmental and Preventive Medicine Unit No. 7 (NEPMU-7), Sigonella, Italy, have begun a series of "mini-war games." We divide into four groups: perpetrators, security forces, NEPMU, and Naval Hospital. The "perpetrators" instigate and control the scenario—war, terrorist attack, or accident, either biological or chemical. The others do not know what the cause is. They only see the results and must respond as the situation unfolds, getting only as much information as would normally come their way in a real situation. Hopefully, these drills will hone our skills for dealing with a catastrophe. The benefit for us is that the scenarios are tailored to the way we would respond if an incident occurred in our own backyards. ❑

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Feature

A New Name and a Modern Mission

LT Pia S. Boston, MSC, USN
COL Kathryn L. Boehnke, USAF, MC
CAPT James Arthur, DC, USN
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The Joint Readiness Clinical Advisory Board (JRCAB) formerly the Defense Medical Standardization Board (DMSB) changed its name and adopted a modern mission to align the organization with the new operational strategies of the military. The vision of the recently renamed, reengineered, JRCAB is to be "The Joint Clinical Connection to Medical Readiness."

Located at Fort Detrick, Frederick, MD, the "Board" as it is commonly referred to, has an extensive history. In 1945 the organization was designated the Army-Navy Specifications Cataloging Committee and was established as the single organization to obtain medical materiel for the services. This was the first joint action to unify military procurement. In 1962, renamed the Defense Medical Materiel Board (DMMB), the organization was empowered as the sole activity to add items to, delete items from, or modify items in the Federal Supply Catalog. In 1984 the agency was designated the Defense Medical Standardization Board in an attempt to reemphasize the standardization mission. Finally, in March of 1998, to align the Board with new initiatives in military medical readiness and, in particular, joint medical logistics, the flag and general officers approved a new name, the Joint Readiness Clinical Advisory Board. In summary, since 1945, this organization has existed as a truly joint service organization. The JRCAB is chartered by the Office of the Assistant Secretary of Defense for Health Affairs and guided by Department of Defense Instruction 6430.2.

The JRCAB executive board is comprised of six flag and general officers, four representing the quad-services, and representatives from the Office of the Assistant Secretary of Defense for Health Affairs and the Office of the Joint Chiefs of Staff.

The executive board generally meets at least twice annually, and a staff of approximately 15 officers and 15 civilians assigned at Fort Detrick carries out the Board's day-to-day operations. The JRCAB support staff consists of a Staff Director (Medical Corps O-6), a Deputy Staff Director (Dental Corps O-6), and five divisions. The positions of Staff Director and Deputy Staff Director are rotated among the services (currently, the Staff Director is an O-6 Air Force medical officer and the Deputy is an O-6 Navy dental officer). The divisions are Administrative Services, Automated Information Support, Clinical Support, Logistics Support, and Pharmaceutical Support.

The primary focus of the JRCAB is to ensure that the right medical materiel is selected for various deployable medical platforms in order to meet emerging and ever-changing medical readiness requirements. The new Joint Health Services Support 2010 initiatives focus on essential care in-theater and the evacuation of service men and women who cannot return to the combat zone within 7-15

days. In pursuit of this new focus, the JRCAB uses approximately 335 patient conditions to represent the broad spectrum of medical casualties expected during war. Each patient condition has an associated clinical pathway or "Treatment Brief" and each "task" within the clinical pathway may or may not have associated medical materiel. The JRCAB responsibility (through specialty selected clinical panels) is to jointly review and revise *all* Treatment Briefs, reflecting the new "essential" care in-theater philosophy, and to identify all medical materiel needed for each task in the clinical pathway. This medical materiel information is then kept in a "Task, Time, Treater" data base to allow searching, reporting, and modeling of the information.

The final responsibility is the actual "joint" selection and standardization of those items needed *in-theater* during the first 60 days of the war (the materiel that *must* be there when the war starts, preplanned, pre-positioned and ready). This work is generally accomplished by "standing" joint committees that meet quarterly to consider items for selection, standardization, and eventual inclusion in the Deployable Medical Systems (DEPMEDS) data base or by subject matter expert panels working under the auspices of the standing committees. The continuing goal is to maximize commonality, compatibility, and interchangeability of medical materiel across the services.

During the past year the JRCAB sponsored many subject matter expert panels that reviewed, revised, and developed clinical pathways for in-theater care for levels (echelons) 1 and 2 for the first 60 days of an armed conflict. Also, panels were sponsored to review and revise clinical pathways that were established for level (echelon) 3 in the early 1990's. All panel members were nominated by their respective Surgeons General for these important meetings.

During peacetime the Board provides specific health services support to the services. This includes clinical consultation, quality assurance, and Shelf Life Extension of Pharmaceutical or military unique substances. The organization provides clinical consultation to the services when they are considering a new medical item for DEPMEDS or when they want to reclassify (e.g., delete, replace, or retain) medical materiel in the data base. Adjudicating and/or reviewing medical materiel quality assurance complaints (SF 380s) is yet another responsibility of the JRCAB. Clinicians at the JRCAB investigate all type I complaints (those with life and death potential) and, in conjunction with the Defense Supply Center Philadelphia (DSCP) and the Food and Drug Administration (FDA), initiate recall actions if appropriate. If the medical materiel complaint is less serious (i.e., a type II or type III complaint), it may only warrant Medical Alerts to notify the services of potential problems.

The Shelf Life Extension program is a joint venture between the Department of Defense and the Food and Drug Administration. This is primarily a pharmaceutical program and has been enormously successful. Since FY92, cost avoidance through the Shelf Life Extension Program has reached $250,000. The FDA tests selected pharmaceuticals about to reach expiration, and if those drugs are still efficacious, they approve expiration extensions. The information concerning the "expiration extension" is then promulgated to all services.

Today, the JRCAB, in pursuit of its new clinically focused mission, is seeking to focus on core competencies. This reengineering initiative will result in an increase in the number of nurses on staff and a reduction in the number of logisticians currently assigned. Already, the organization has archived all data base information above echelon (level) 3 and discontinued the management of Service Specific Assemblages. The JRCAB believes the Treatment Briefs and the Task, Time, and Treater (TTT) database for *in-theater* medical care, are the core essentials of the organization. These entities must be constantly reviewed, revised and revalidated and easily accessible for all military health care providers.

As we approach the millennium, Soldiers, Sailors, Airmen, and Marines can expect more changes in their respective service's operational strategy. The current climate requires flexible application of our military assets and many philosophical changes to traditional concepts of force deployment. Joint Vision 2010, the Joint Health Services Support Vision 2010, and the Joint Medical Logistics Vision 2010 are prime examples of important philosophical changes that will significantly affect operational medicine. In this sea of change, the JRCAB has altered its course, and is on track with a new mission and vision. ❑

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Feature

Sub-Saharan Africa: Navy Medicine's Operational Role in the New World Order

LT Youssef H. Aboul-Enein, MSC, USN

The past decade has seen profound change on the African continent. These changes include democratization, economic progress, and an end to Soviet and Cuban military intervention. Post-Cold War Africa has also seen the return of ethnic hatred, state collapse, and humanitarian disasters. It is the policy of the Department of Defense to support democracy, provide humanitarian assistance in order to nurture regional security arrangements and conflict resolution as well as encourage economic assistance.(*1*) Sub-Saharan Africa is the new frontier in which Navy medicine can play a vital role in the 21st century. U.S. military involvement on the continent has been primarily humanitarian and noncombatant in nature.

Line commanders are keenly aware of the importance medical plays in coordinating and planning noncombatant evacuation operations (NEO) as well as humanitarian operations. Navy medical officers and hospital corpsmen must be sensitized to the many questions a Joint Task Force Commander will ask during an operation. As we approach a new millennium, the "Doc" has been given a louder voice in the Crisis Action Team (Marine Corps and Navy teams assembled aboard an amphibious flagship designed to quickly analyze and develop plans to execute a specific mission). The result of soliciting medical's input has been lower casualties from disease, illness, and an understanding of how mass starvation and lack of preventive measures can grind a humanitarian mission to a halt.

Total Health Care Support Readiness Requirement (THCSRR)

The THCSRR model was created to precisely identify Navy medicine manpower requirements to meet the operational mission both in peace and wartime. Aligning these requirements with operational platform and deploying billets creates a sense of increased responsibility for Navy medical staff, officer and enlisted, to become more operationally aware. This awareness includes platform familiarization and an awareness of shore facilities and units that provide support to medical assets afloat. Navy medicine must continue to create opportunities to serve the line by marketing our capabilities to field commanders as well as members of the Joint Staff that task line commanders afloat and ashore.

Lessons from Liberia: Assured Response 96

When the operational order (OPORD) was issued to conduct a potential NEO evacuation and reinforcement of

the U.S. Embassy in Monrovia, the team of medical professionals on board USS *Guam* (LPH-9) formulated a barrage of questions that required clear answers. It would be less than 2 weeks and USS *Guam*, along with USS *Trenton* (LPD-14) and USS *Portland* (LSD-37) accompanied by the 22nd Marine Expeditionary Unit, would be on-station in West Africa. Through cooperation with the Navy Environmental and Preventive Medicine Unit No. 7 (NEPMU-7), the Sixth Fleet Surgeon's Office, and products issued by the Armed Forces Medical Intelligence Command (AFMIC) some of those questions were answered. Other questions required the assistance of both Marine and Navy personnel on the boat. Questions that needed to be answered included:

- What type of preventive medicine measures would be needed before arriving on-station and during the deployment?
- What type of malaria prophylaxis would be suitable for this mission?
- Who should be issued malaria prophylaxis and for how long?
- What were the potential diseases and illnesses the noncombatant evacuees would have? And how do we address them?
- Do our AMALS have everything we need and if not how do we re-supply before leaving the Mediterranean and while off the Liberian coast?
- Could we handle this with the medical personnel on board? If not, would we request augmentation?
- What medevac routes would we use, and what were the closest MTFs that would support us off Liberia?
- What plans do we need to make for an extended stay in West Africa?

Medically Planning a NEO and Getting Those Questions Answered

Planning in the amphibious Navy never occurs in a vacuum. It is a coordinated effort between Navy and Marines. It takes patience, an understanding of your requirements, and effective communicators to achieve answers to what seem relatively simple questions in hindsight. From the Amphibious Squadron staff there are several key people. The Intelligence Officer (N-2) will key medical in the information superhighway, downloading the latest information from the Armed Forces Intelligence Command (AFMIC). AFMIC provides a wealth of medical information on the nations we will operate in. For Assured Response 96 we were interested in Liberia (Area of Operation), Sierra Leone (Our Logistics Base), and Senegal (stopover for our Marine KC-130 logistics flights). Using advice from NEMPU-7 we estimated that $200,000 worth of antimalarial medication was needed to cover Navy and Marine Corps personnel participating in the operation. The Amphibious Squadron Logistics Officer (N-4), Ship's Supply Team in collaboration with the Medical Service Corps officer were able to draw the needed supplies from Department of Defense warehouses in Pirmasens, Germany. The Air Squadron (N-5) planned to have all medical supplies airlifted to the ship as we rounded the Straits of Gibraltar. NEPMU-7 sent us a senior chief who was a preventive medicine specialist.

The need to plan a medevac route from Liberia required a quick geographic orientation, an understanding of the frequency of regular logistics flights, and analyzing which airfields could accommodate planes from the 86th Aeromedical Evacuation Squadron. This was done in conjunction with the Tactical Air Squadron OIC (N-5) and PHIBRON Logistics Officer (N-4). Finally, the CATF Surgeon decided augmentation was required and we needed to pull staff into theater to deal with children and pregnant women. Coordinating with the Sixth Fleet Surgeon's office and Commander-in-Chief Naval Forces Europe (CINCUSNAVEUR) Surgeon we were provided a gynecologist, pediatrician, two specialty nurses, and a corpsman from Naval Medical Center San Diego, CA. within 1 week of identifying the requirement. There was no need for a full MMART team and the personnel were more than adequate to support our needs. Although a shipboard NEO did not occur in Assured Response 96, a mobile medical clinic was set up at the Intermediate Support Base in Freetown, Sierra Leone, which cared for troops and Liberian refugees.

Developing plans for evacuee processing and their embarkation aboard required the attention of the ship's medical officer, executive officer, CATF Surgeon, and Medical Service Corps officer. The NEO-bill involved medical personnel both on the beach and aboard the casualty receiving and treatment ship. Even though USS

Guam had no NEOs aboard the drill was constantly practiced and refined. It involved six processing stations in which two involved medical on board USS *Guam*.

Training Medical Planner to "Pull" Information and Assistance

The emphasis on training junior Medical Service Corps officers with orders to an operational billet should be in the art of acquiring information. This is the first step to bringing medical personnel and materials requested to the deck of the ship. Leaving the pier with names, numbers, chains of command, and adding to that book helps in the coordination and safe arrival of supplies and medical augmentees. The chain of command was an effective tool in bringing assets to the deckplates. The art is articulating your needs via phone or message and conveying how you wish to address problems in the field or afloat. Be mindful that keeping the chain informed is not a tiresome chore but a means to educate your superiors on the situation so they can assist you. Another word of caution, do not fall in love with your medical plan. Contingencies involve friction and required a high degree of flexibility. View plans as an attempt to gain some control over a rapidly changing situation. Among the measures of success experienced in Liberia:

- Malaria prophylaxis acquired while enroute to West Africa, enabling all Navy and Marine Corps personnel to be given medication prior to arrival on-station.
- Three cases of malaria were diagnosed out of 2,000 Marines rotated through Liberia.
- Successful lifesaving thrombolytic therapy and medevac were provided to the U.S. Charge d'Affaires.
- The combined medical team composed of members of Fleet Surgical Team SIX, 22nd MEU (SOC), and augmentees from San Diego provided care to military personnel and refugees in Sierra Leone.

Africa: Navy Medicine's New Challenge

In 1997 teams of U.S. Army specialists from Fort Bragg, NC, traveled to Uganda and Senegal to train battalion-size African forces in peacekeeping. Seven African nations also provided 8,000 troops for the purpose of stabilizing conflict zones so humanitarian aid could be provided to civilians without interference. (*2*) In 1999 internal conflict again required a United Nations sponsored force to help broker an end to Sierra Leone's brutal civil war. Although the United States was not directly involved, Navy medicine may in the future again play an active role in shaping an all-African force from the medical perspective. The improvement of basic health, education, and nutrition is a required foundation to Africa's long-term development and as such an educated African military would be well-suited to teach basic literacy and hygiene to people in rural areas. (*3*) This would preoccupy peacetime African forces in the development of their respective countries instead of meddling in political intrigue and gain.

One of the most complex operations is humanitarian in nature. The military deals with factional fighting, starvation, disease, nongovernmental organizations (NGOs), the United Nations, and the State Department. Remember, as medical, you have a chain of command and although you are not expected to feed everyone or replace NGOs serving in these war-torn nations, be operationally aware and give your line commanders an honest estimate of the situation.

Conclusion

Navy medicine has gone to Zaire, Liberia, and Sierra Leone and has been asked to provide guidance in conducting effective operations in the region. Be astute, use all your resources, and train for these contingencies. An Amphibious Task Force gets under way assuming an NEO or humanitarian operation will occur. Military Operations Other Than War have brought medical planning to the forefront. Operations like Assured Response in Liberia or those in Zaire are glimpses of what the future holds for operational medicine as we struggle to cope with problems inherent in the new world order.

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Feature

Hearing Conservation:
The Engineering Part of the Equation

Kurt Yankaskas

Hearing conservation is preventive medicine. In the world of acquisition reform, it is not customer-particular. The high noise environment, which causes hearing loss, is pervasive throughout the military services and, more dramatically, in a shipboard environment. Hearing damage is gradual and more likely shows up later in one's career than earlier. Awareness of the causes is increasing. A recent article in *Navy Medicine* announced a remarkable breakthrough in the reversal of hearing damage due to high noise environments. Moreover, VADM Richard A. Nelson, MC, Surgeon General of the Navy, has repeatedly and forcefully advocated Force health prevention.

The Navy's engineering community can contribute to the hearing conservation effort. In particular, the vast expertise in ship noise control developed by the Navy during the Cold War can be harnessed to benefit the hearing health of today's present Force. Since a large percentage of Navy personnel experience hearing loss due to high noise environments, we must use that engineering expertise to reduce the hazard.

The focus of this article is the aircraft carrier. The close proximity of man and machine, i.e., ships and aircraft, presents a most significant challenge. If one is to make significant changes, then our carrier fleet of 10 ships carrying a large proportion of our Sailors, must be the main focus of attention and presents an excellent opportunity to make major strides in hearing health.

Total Ownership Costs

The obvious ownership costs for any ship are its construction, lifecycle support, manning, and disposal costs. The hidden costs include health claims for hearing loss for both active and retired personnel, and the effects of noise on ship habitability. Habitability is known to have a direct impact on retention and recruitment.

The effects of high airborne noise levels can be temporary or permanent depending on the amount of exposure. There are numerous anecdotal stories of hearing difficulties or "ringing" in Sailors' ears after a CVN deployment. The impact of hearing conservation issues, partially measured by hearing compensation claims submitted to the Navy, carries high direct and indirect long-term costs.

Percentages are deceiving. By the numbers, aircraft carriers are home to 33 percent of the at-sea Sailors, even though these vessels represent only 3 percent of the U.S. Fleet.(*1*) Therefore, any investment in CVN silencing has high impact on, and consequently high possible dividend for, future programs. This effect is amplified when one considers that the original aircraft carrier design dates to the 1960's when our knowledge of noise control was in its formative stages.

The May-June 1999 issue of *Navy Medicine* details some of the job specialties, which have associated hearing risks. This information is drawn from work conducted by Wolgemuth. Additional data is available on the cost of hearing disability claims. Some 77,000 servicemembers currently collect veteran's benefits as a result of hearing damage. Of these, a full 75 percent list hearing loss as their primary disability. The associated cost to the Veterans Administration is more than $270 million annually. But under managed health care, these figures may not reflect the total cost. "Our best estimate is that 275,000 active duty Navy and Marine Corps members are routinely exposed to hazardous levels of occupational noise," says CDR Glen Rovig, an audiologist with the Navy Environmental Health Center in Norfolk, VA. That is 50 percent of an active duty population of some 554,800. "Hearing and balance problems are a significant social, financial, and readiness concern," says LCDR Michael Hoffer, Director, Department of Defense Spatial Orientation Center in San Diego, CA. In an attempt to mitigate these problems, the Navy conducts sound surveys when ships are built for the purpose of classifying those shipboard areas that require Sailors to wear hearing protection.(*2*)

A more representative cost estimate can be developed from other existing data. In the research of over 12,000 medical records from 154 ships

CVN Airborne Noise

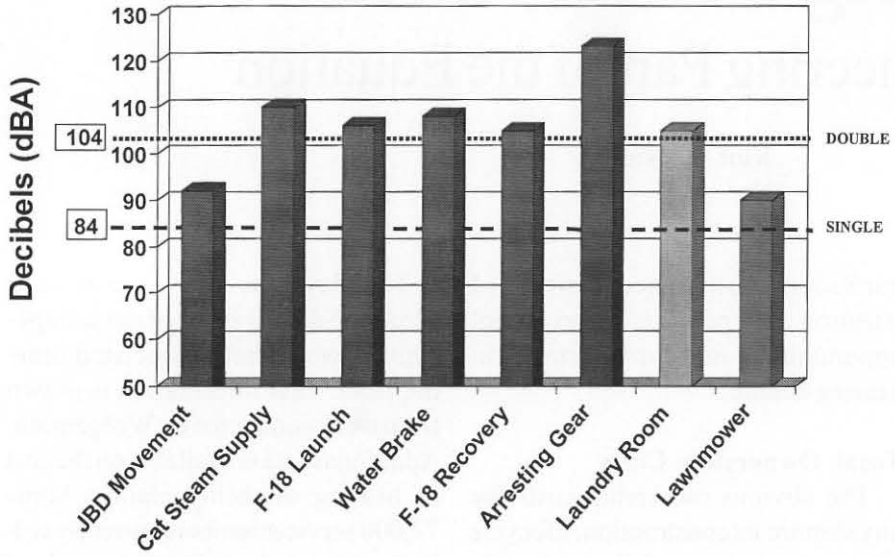

Figure 1

and submarines(*3*) it was found that 29 percent of Sailors may be expected to suffer hearing damage. This rate would indicate that throughout the Navy, 107,323 personnel out of the 370,079 active duty personnel will suffer hearing damage. This rate is 8.5 times the rate for noise-induced hearing loss of the general U.S. population (3.42 percent). At $3,900 per claim per year, over a retirement period of 30 years, the cost of hearing damage could be as high as $12.6 billion.(*4*) With respect to CVN personnel, data would indicate that 33 percent of our Sailors serve a portion of their careers on carriers. The associated cost of hearing damage for CVN personnel alone could therefore be as high as $4.2 billion. A hidden cost of this magnitude presents an excellent opportunity to make vast improvements. Therefore, the Navy can realize substantial savings if hearing claims compensation, and the costs associated with low retention (first-term retention goal 38 percent; current retention rate 32-33 percent, per Reference *5*) and low recruitment within the service can be reduced. By bringing together the work of the engineering, safety, and medical communities, future improvements in aircraft carrier acoustic design are achievable.

It is worth noting that historically, even though acoustics engineers have not "owned" any shipboard systems, they are, in fact, responsible for the quieting of all systems. This puts them in a unique position. It gives them the responsibility for performing total systems engineering on an ongoing, day-to-day basis.

Aviation at Sea

Flight operations are the lifeblood of aircraft carriers. Such operations expose both flight deck and below deck personnel, those personnel interfacing with ship and aircraft, to varying degrees of intermittent noise. These noise levels have been documented on two operational carriers with at-sea measurements.(*6*)

The flight deck during flight operations is a dangerous and noisy environment made safer by training. The noise levels on the flight deck are intense and easily exceed 104 dBA, which mandates double hearing protection. Vigilance in wearing the proper level of hearing protection and the proper fit is essential to hearing safety. Flight operations and gallery deck machinery are not the only noise concerns on the ship. Figure 1 shows noise levels encountered below the flight deck during flight operations and other evolutions. Some of these events which the crew is exposed to are jet

Crew Compartment Airborne Levels - Selected Platforms

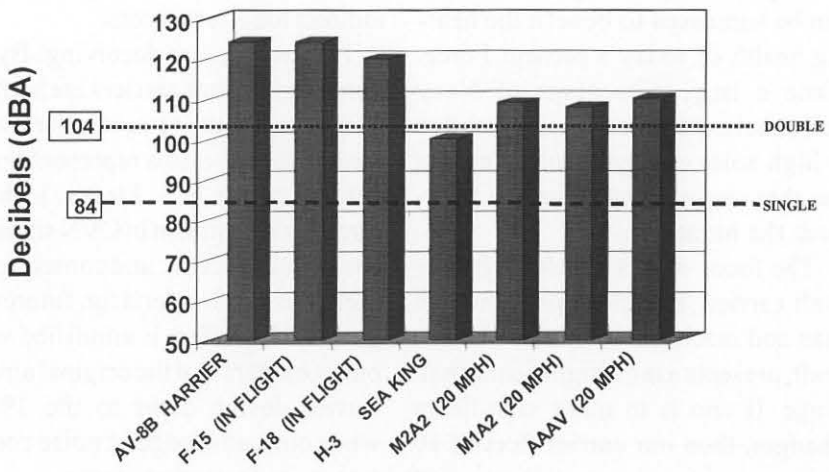

Figure 2

Previous Quieting Investments

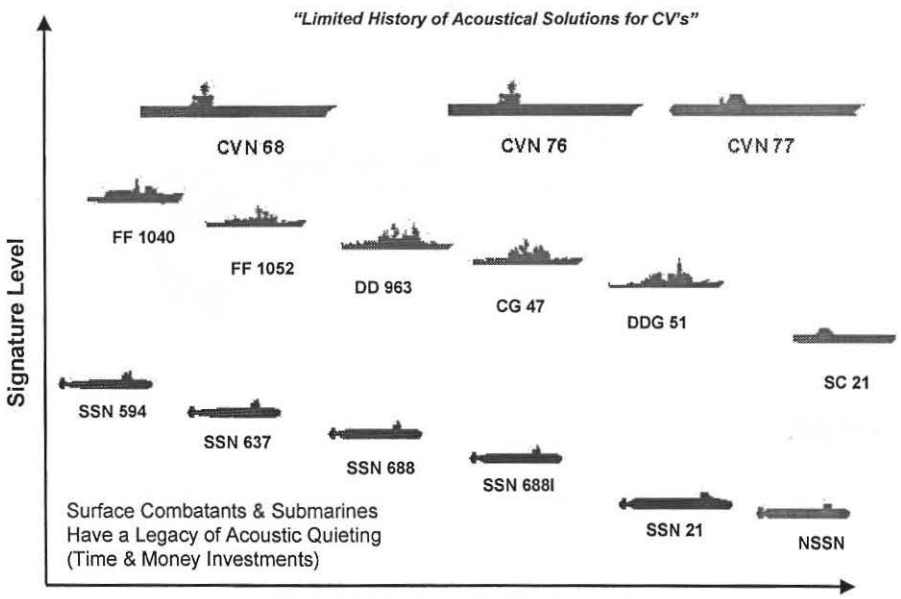

Figure 3

blast deflector movement (hydraulic noise), jet aircraft engines at full power, catapult launch, waterbrake, arresting gear machinery, and arresting cable slap. Additionally, in the laundry room the propeller is the dominant noise source but may be remedied with a modern propeller design. It is this environment that flight crews, and others who work in high acoustic noise environments, use for audiological recovery.

The problem of noisy military work environments is not limited to the Navy. Marine Corps, Air Force, and Army personnel are exposed to similar noise levels. For comparison purposes, Figure 2 presents acoustic energy levels measured inside such military vehicles as the F-15, AV-8B, Abrams M2A2 Tank, M1A2 Bradley Fighting Vehicle, and the Advanced Amphibious Assault Vehicle (AAAV). Developing solutions for the aircraft carrier has crossover applications to these other vehicles.

Solutions

Fight operation noise mitigation has many possible solutions. The analysis of flight operations noise has followed a source, path, and receiver strategy. This approach was developed under numerous Navy ship silencing programs. The pervasive nature of acoustics lends itself to this approach and facilitates leveraging from surface ship and submarine acoustic technology developments. Capitalizing on a 30-year investment in surface ship and submarine silencing programs, there are a number of solutions for noise mitigation as shown in Figure 3. As the techniques of noise control are well understood, their utilization depends on the level of risk mitigation employed and the level of engineering investment to be made early in the design process.

A Total Ship Engineering approach will also examine alternative treatment schemes. Several projects that are being pursued have potential acoustic benefits for noise mitigation. And it is important to remember that a total systems approach must be maintained. For example, acoustic insulation does provide thermal insulation benefits, and a systems engineering approach would lead to the optimum application of dual use insulation which would minimize installation weight. Additionally, all noise sources for a given space must be considered and treated. If other noise sources are allowed to dominate in the newly treated spaces, the acoustic fix will be perceived/measured to be ineffective. It is a reminder of the acoustic lessons learned in the last three decades: attention to detail is critical for successful noise control. The success of this depends on every individual involved in the design. The Society of Naval Architects and Marine Engineers (SNAME) Design Guide for Shipboard Airborne Noise Control provides the basic concepts for noise control but does not address flight operations.(7) These methods used in conjunction with other design efforts can produce effective solutions for noise mitigation.

Noise Source Control

The best way to control noise is by directly treating the noise source. Commercial aviation has already had success in this field. Airport noise abatement procedures restrict flight operations at Washington Reagan National Airport, Washington, DC, before 0700 for noisy aircraft like the older three-engine Boeing 727. However, modern aircraft such as the Boeing 757 are quiet enough to meet the lower noise requirements for earlier departures dictated by noise abatement requirements. This has been achieved by utilizing bypass air in engine design. The incorporation of quiet design features in military aircraft, incorporating a total systems engineering approach, would allow a smart design resulting in lower source levels.

Immediate noise abatement can also

be achieved by treating the noise path(s)(Figure 4). Noise path control may be a more cost-effective and immediate method with a shorter implementation schedule, both in backfit and forward fit applications. One must remember that noise path control can become very complex as noise paths can vary as a function of frequency and noise level. For example, in the human body, bone conduction of noise begins to become a noise path at noise levels above 135 dBA according to CAPT Robert Hain (NSMRL). Thus, in some cases, a limit to noise attenuation can be approached.

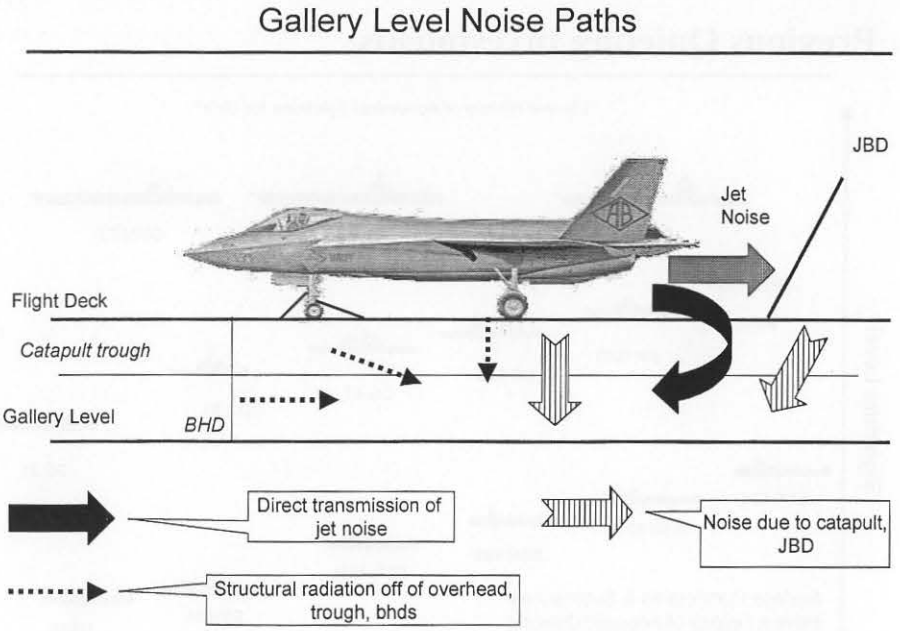

Figure 4

Noise Path Control

The aircraft carrier environment provides a golden opportunity for successful noise control, particularly since the *Nimitz* Class is entering its overhaul cycle. Acoustic solutions, for example, are minimal on the CVN-68 *Nimitz* Class ships. The basic treatment for the 03 deck is 2 inches of thermal insulation (fiberglass) in the overhead and 6 inches on the catapult troughs for thermal control. Fiberglass thermal insulation also has some acoustic benefits. However, the acoustic requirements due to structure-borne noise propagation go beyond the current thermal requirements. Measurements show that bulkhead vibration contributes significantly to compartment noise levels. Supplementing the existing thermal treatments with acoustic materials may have some additional thermal advantages.

Conventional Noise Control Treatments

The classic treatment to control noise is the addition of insulation to absorb/attenuate acoustic energy. Therefore, effective noise mitigation will involve both overhead and bulkhead treatments. A good example is the Library/Chaplain spaces. To have any significant effect on peak noise levels there, a high transmission loss (HTL) material should be applied to the overhead, troughs, and all bulkheads throughout the Library/Chaplain complex. The HTL treatment should be applied to the troughs along with a minimum of an additional 2 inches of thermal insulation between the trough and the HTL layer. The HTL treatment should have nominal thickness 4 1/8 inches and a septum density of 1.5 lb per square foot. Reference *8* provides detailed guidance for the installation of bulkhead and overhead treatments, including HTL treatments.

Ceiling system modifications will also be required in the Library/Chaplain complex, including piping, electrical (wire ways, lighting, loudspeakers), thermal, HVAC, etc., in order to make room for the recommended noise control treatments, and to ensure that flanking paths for noise are not present. Reference *8* depicts such an installation for the CVN-75 Library/Chaplain complex. In order to achieve the full acoustic benefit of this treatment with minimal technical risk, lagging treatments on HVAC ducts, installation of a suspended ceiling, installation of lighting fixtures in the suspended ceiling, and placement of piping above the suspended ceiling should be included as part of a baseline treatment.

Integrated Joiner Bulkhead System

The Integrated Joiner Bulkhead System (IJBS) has been proposed for CVN's as a fabrication cost savings measure. Other navies for their berthing have utilized similar systems. The various manufacturers of those systems claim 30-40 dB of acoustic transmission loss with attendant fire and shock qualifications. It should be noted that similar systems are utilized on cruise ships. But certainly, with the correct selection of materials and structural isolation from the overhead (i.e., flight deck), significant gains are potentially realized in noise mitigation.

Materials

There are two areas of materials, which need follow-on investigations. The first is in the area of visco-elastic laminated sheet metal. Laminated

sheet metal has a sandwich layer of damping material to reduce vibration energy. The material is used by the automotive and general aviation industries to reduce the transmission of noise to the vehicle's occupants. Certainly, this is a candidate substitute material for joiner work. The other concerns insulation materials currently under evaluation with the SBIR Program (Topic N96-269-II) and the NAMRL acoustic material. Again, there is potential for application for flight operation noise mitigation.

Engineering At-Sea Demonstration (12 Pack)

The Naval Sea Systems Command (NAVSEA) has proposed an at-sea evaluation of several noise control treatments to determine the optimal design and producibility. A small-scale demonstration of noise mitigation is necessary prior to a large-scale effort to mitigate noise levels under a 4.5-acre flight deck.

This concept has been subtitled the 12 Pack, and is due to the proposed test location on the 03 Deck between Frames 89 and 96. The area is comprised of 12 berthing spaces of near identical size and noise environment. Design analysis shows flight operation noise mitigation is readily achieved with acoustic material applied on the overhead and bulkheads. The location between Catapults 1 and 2 would allow an at-sea evaluation of five or six acoustic treatment schemes as actual installations.

The goals of the project are to demonstrate that noise mitigation is possible under actual flight operations conditions. Successful noise mitigation here should be achieved prior to committing to full application to the gallery deck. Once acoustic performance has been demonstrated, then an engineering effort to optimize weight and acoustic performance can follow. The tentative candidates are an integrated bulkhead system, NAMRL acoustic material, laminated sheet metal as well as classic insulation designs. The 12 Pack Project is a candidate for FY00 execution, sponsored by the Bureau of Medicine and Surgery (Research and Development—MED-26).

Smart Signs

An overall concern of everyone aboard an aircraft carrier are noise levels in workspaces. A "Smart Sign" has been proposed upon which colored lights would energize depending upon the existent noise levels. The technology actually comes from the PC-1 Class Active Noise Control System. A logic chip would sense existent noise levels. A green light would indicate noise below 84 dBA, a yellow light for levels between 84 and 104 dBA, and would trigger the need for single hearing protection. A red light for levels above 104 dBA would indicate the requirement for double hearing protection. This would be a constant reminder of the dynamic nature of flight operations noise.

Active Noise Control

Active noise control (ANC) works best when the offending source is finite and well defined, the transmission path is well defined, and/or when the receiver space is finite. Furthermore, active noise control solutions are utilized when passive treatment(s) have been implemented to achieve high-frequency noise control. The larger spaces have more paths to cancel, requiring more sensors and actuators, which increases acoustic signal processing requirements. ANC is usually used for low frequency. Some Saab aircraft have ANC systems, with roughly 39 sensor/actuators pairs. Although there are specific marine applications of active noise control in the Navy, ANC technology is not yet sufficiently mature for aircraft carrier application.(*9*)

Conclusion

The equation for a total solution in hearing conservation includes both medical and engineering components, and resources must be allocated to both sides of that equation. Medical specialists can identify the high-risk individuals and the high-risk conditions needing engineering development. Noise mitigation techniques must be applied to our current ships and vehicles and at the onset of any design project. This is especially critical for our future high performance vehicles. Accomplishing the mission need not be jeopardized as we improve the quality of life for our Sailors.

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In Memoriam

RADM Harry S. Etter, MC (Ret.), former Deputy Surgeon General, died of complications of cancer at the National Naval Medical Center, Bethesda, MD, on 26 July 1999. He was 83.

Dr. Etter was born in Shippensburg, PA, on 15 Oct 1915. He attended Duke University, Durham, NC, as an undergraduate and received his M.D. degree from the medical school of that university in 1939. In 1940 he began his internship at Bellevue Hospital in New York City and the same year was appointed as Acting Assistant Surgeon for intern training. He was commissioned Assistant Surgeon with the accompanying rank of LTJG in the Navy in 1941.

Dr. Etter interned at Naval Hospital Portsmouth, VA, until April 1941, after which he reported to the Naval Medical School, Washington, DC, for further instruction. That summer he joined the staff of Commander Destroyer Division Fourteen as Division Medical Officer, and from January 1942 to January 1943 served as medical officer of USS *Madison* (DD-425) which operated as a unit of Destroyer Division Fourteen, performing convoy and patroling duty in the North Atlantic during the early months of World War II.

Following his duty at sea Dr. Etter had postgraduate instruction at the Mayo Clinic, Rochester, MN, and then reported as Chief of the Physical Medical and Rehabilitation Department at Naval Hospital Bethesda, MD. He remained there until war's end in September 1945 and was then assigned to the Physical Medical Division, Bureau of Medicine and Surgery (BUMED), Washington, DC. He was then an instructor in Atomic, Biological and Chemical Defense at Treasure Island, San Francisco, CA, until 1951, when he returned to BUMED as Head of Atomic Defense. He served in that office until 1954 when he assumed duties as Director of the Special Weapons Defense Division.

In 1955 he reported to the Naval War College, Newport, RI, and after completing the Naval Warfare and Senior courses, joined the staff of CINC-PACFLT from 1956 to 1959. He next served as Medical Director at the Naval Radiological Defense Laboratory, Naval Base, San Francisco. In 1961 he returned to BUMED as Director of the Planning Division. Four years later he became executive officer of Naval Hospital Portsmouth, VA, and the following year assumed command of Naval Hospital Bethesda.

In 1967 RADM Etter was assigned as Assistant Chief for Planning and Logistics, BUMED, and in 1973 became Deputy Surgeon General. He retired in 1974.

Dr. Etter held the American Defense Service Medal, American Campaign Medal, World War II Victory Medal, the National Defense Service Medal, the Distinguished Service Medal, and the Legion of Merit.

Mary Rose Harrington Nelson, a World War II Navy nurse who spent more than 3 years as a Japanese prisoner of war, died at age 86 on 17 June 1999, at her McLean, VA, home. She was buried in her white Navy uniform with full military honors. (See *U.S. Navy Medicine*, May 1982.)

A graduate of St. Joseph's Mercy Hospital Nursing School in Sioux City, IA, "Red" Harrington reported to Naval Hospital San Diego, CA, in 1937. Her request for an overseas duty resulted in assignment to the Canacao Naval Hospital, south of Manila at the sprawling Cavite Navy Yard in January 1941. This tropical paradise seemed the ideal assignment until 8 Dec 1941 when war came to the Pacific. Harrington was on night duty when she heard the Japanese had just bombed Honolulu and wondered whether the city or the cruiser of the same name had been the target.

Two days later when Japanese bombers virtually destroyed the Navy yard, Mary Rose and 11 other Navy

nurses triaged the wounded without pausing to think about the horrific number of casualties and the fires that burned around them. On 11 Dec, the hospital staff evacuated to the relative safety of Manila.

With the fleet gone and the Army having retreated to the Bataan Peninsula, these nurses and medical staff set up an improvised hospital at St. Scholastica School in Manila for over 100 patients.

On 2 Jan 1942, the defenseless city surrendered to the Japanese, and the 11 nurses minus LT Ann Bernatitus, who had gone to Bataan with an Army medical unit, then observed the lowering of the Stars and Stripes.

The Japanese held these women along with foreign national civilians in Santo Tomas, a former university, reconfigured as a makeshift civilian internment camp that eventually housed 4,000 prisoners. Captured military men went to brutal POW camps.

The Navy nurses helped organize a hospital in Santo Tomas, where Mary Rose set up and worked in the hospital laboratory. There she became an expert with malaria smears and identifying tropical parasites and bacteria. Known among the other prisoners as a spirited young woman, she did her job and refused to be despondent about her circumstances. It would be over a year before her mother, back in San Diego, learned that Mary Rose was a prisoner-of-war.

In 1943 the Navy nurses volunteered to set up another prison hospital at Los Banos, the site of an agricultural college. There, Mary Rose taught young men how to be aides and help with patient care. One of these trainees was Thomas Page Nelson, a civilian U.S. Treasury Department official who became her future husband.

Months in captivity turned into years. By 1944 the food ration was less than 1,000 calories a day. Several men were shot and killed trying to leave the camp to get food for the starving prisoners. Mary Rose's weight dropped from 130 to 95 pounds. In February 1945 a combined force of U.S. Army paratroopers, ground troops, and Filipino guerrillas rescued the prisoners in a dramatic raid on Los Banos, well behind Japanese lines.

Mary Rose and Page Nelson married in San Diego on 13 April 1945. They settled in Northern Virginia and Page returned to his prewar job at the Treasury Department. For years she and her husband did not discuss their wartime experiences. However, their children and grandchildren knew that food was not to be wasted. Their grandson noted that he had never seen anyone clean a plate as well as his grandmother. In an interview with *Navy Medicine* 2 years before her death, Mary Rose Nelson's keen sense of humor remained intact over half a century after her captivity. When asked how bad things had been in Santo Tomas, she replied, "It got to where a woman could walk down the hall in that place completely naked and no one would even look up unless she was carrying a ham sandwich in each hand."

For 40 years Mrs. Nelson volunteered in Fairfax County schools and for the Red Cross, administering polio vaccines in the 1950's and running numerous blood drives. In 1997 she received the Outstanding Volunteer Award from the American Red Cross. Interviewed on numerous occasions about her POW experiences, she also testified before Congress and a Presidential Commission. She also participated in the dedication of the Women in Military Service to America Memorial (WIMSA) in October 1998.

BUMED Archives

CAPT Clyde Camerer, MC, welcomes LT Mary Rose Harrington (left) and LCDR Laura Cobb to Hawaii after their liberation.

Book Review

Tyquin, Michael B. *Gallipoli, The Medical War. The Australian Army Medical Services in the Dardanelles Campaign of 1915.* New South Wales University Press. New South Wales, Australia. 278 pages, 1993.

Historian Michael Tyquin contributes a book in the New South Wales University History Series worthy of scrutiny by Navy medicine professionals. *Gallipoli, The Medical War* is a detailed work describing all medical aspects of this failed World War I amphibious assault against entrenched Turkish forces holding the strategic Dardanelles. This operation resulted in 21,580 Australians wounded and led to the medical evacuation of 94,012 patients from the Mediterranean Expeditionary Force (MEF) within 3 months.

The book is comprehensive, describing all medical aspects of the Gallipoli campaign. Readers will learn the types of hospital ships used by the British as well as medical evacuation routes and methods employed to extract patients from the field.

The wounded would end up in field hospitals set up on the Greek island of Lemnos, the island of Malta, and makeshift hospitals in Cairo and Alexandria. Also in Egypt, luxury hotels were converted to hospitals leaving 10,600 beds free to receive casualties.

The author ably describes the treatment of a host of hideous gaping wounds inflicted by artillery and machine gun fire and the revelation that maggots feasting upon necrotic tissue debrided wounds more thoroughly than could a skilled surgeon.

The book is highly critical of the lack of planning and poor communication and cooperation between Australian and British medical units that allowed hospital ships to depart with no patients on board. Both British and Australian medical professionals often fought amongst themselves wasting valuable time and resources. Frequent food and water shortages resulted in the issuing to each fighting man of a single pint of water per day and their subsistence on a diet of canned beef, biscuits, and condensed milk. Some soldiers augmented their meager food supply by tossing explosives into a stream to stun fish. Needless to say, fresh produce was a rare commodity.

One chapter covers the effects on the fighting forces by such diseases as paratyphoid, diarrhea, and gastritis. So bad was dysentery that military police had to enforce hygienic standards. Many casualties, therefore, were the result of noncombat-related injuries. Nearly 6,300 Australian troops required dental care with many arriving at the front complaining of mouth pain and unable to fight.

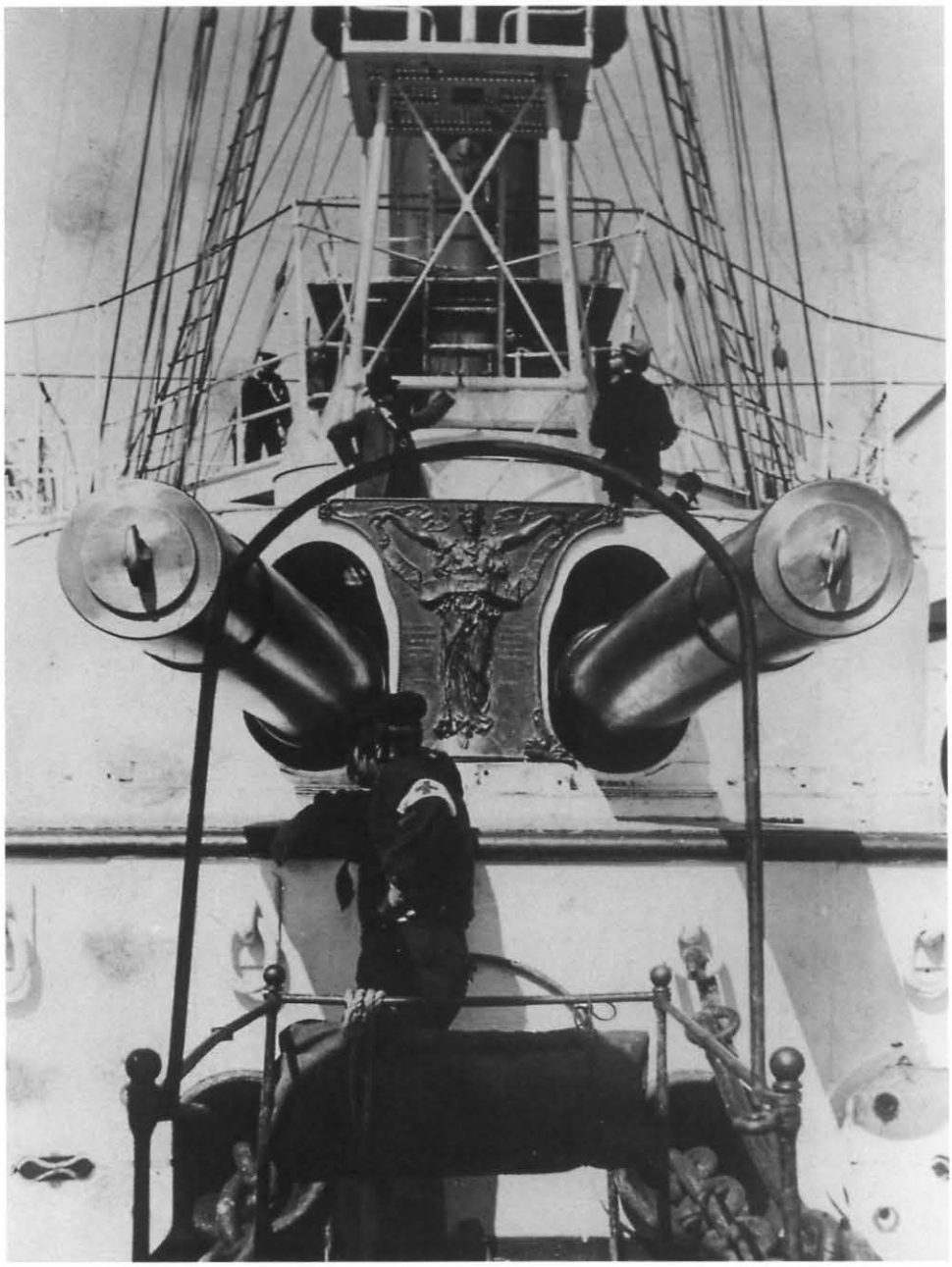
Nevertheless, many innovations in amphibious medical care during that grim 1915 campaign have been modernized and are used today. Examples include the black boats that brought troops and supplies ashore, departing the beach with casualties aboard. Today we use helicopters in much the same fashion, taking advantage of what we now term "lift of opportunity."

The book contains eight fascinating chapters and nine appendices filled with revealing statistics comparing Gallipoli to the South African Boer War. In that conflict, casualties were minimized as physicians and other caregivers paid scrupulous attention to disease prevention and personal hygiene.

Tyquin's book is an education on all medical aspects of the landings and their aftermath. So important were the lessons of Gallipoli that the United States Marine Corps spent an entire year during the 1920's studying the campaign. Pick up *Gallipoli, The Medical War* and learn why this ill-fated campaign nearly led to the premature demise of amphibious warfare.

—LT Youssef H. Aboul-Enein, MSC, USN, Plans, Operations and Medical Intelligence Officer, Naval Hospital Great Lakes, IL.

Navy Medicine ca. 1900



Naval Historical Center

Navy hospital corpsman stands before USS *Olympia* (C-6) forward 8-inch gun turret. The plaque between the guns commemorates the Battle of Manila Bay.

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